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THE TRANSMISSION AND ADMINISTRATIVE CONTROL OF MEASLES *

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INTRODUCTION

This paper records the experience and observations of the writer in handling an epidemic of measles in the city of Palo Alto, California, in the summer of 1914. Careful record was kept of the majority of cases, and a number of experiments in handling the outbreak were tried. In view of the evidence here presented, taken with certain recent experimental work, I propose to show that the usual methods of handling outbreaks of measles are inadequate, and I shall outline a more rational method of control.

STATISTICS OF THE POPULATION IN PALO ALTO

At the time of the epidemic, the population of Palo Alto, according to the City Engineer's estimate based on water consumption for the year, was 5,300 persons. According to the figures of the Federal Census for 1910, 51.1% of these were females. Based on a partial age distribution census, taken by the health department of Palo Alto in connection with a sanitary survey made just previous to the outbreak, the age distribution of this population expressed in percentages of the total population was approximately as follows:

Under 1 year	0.5%
2- 5	5.8%
6- 10	7.8%
11- 15	6.2%
16- 20	8.2%
21- 30	19.9%
31- 40	19.2%
41- 50	15.2%
51- 60	8.2%
61- 70	4.2%
71- 80	2.8%
81- 90	1.8%
91-100	0.2%
Total	100.0%

The native whites with native parents comprised approximately 56.7% of the total population; the native whites with foreign or mixed parentage approximately 23.5%; the foreign whites 16.2%; the negroes 0.5%; and the Asiatics 3.1%. With approximately 1,300 dwellings and approximately 1,370 families,

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the average number of persons per dwelling was approximately 4, and the average number of persons per family approximately 3.86.

A BRIEF DESCRIPTION OF THE EPIDEMIC

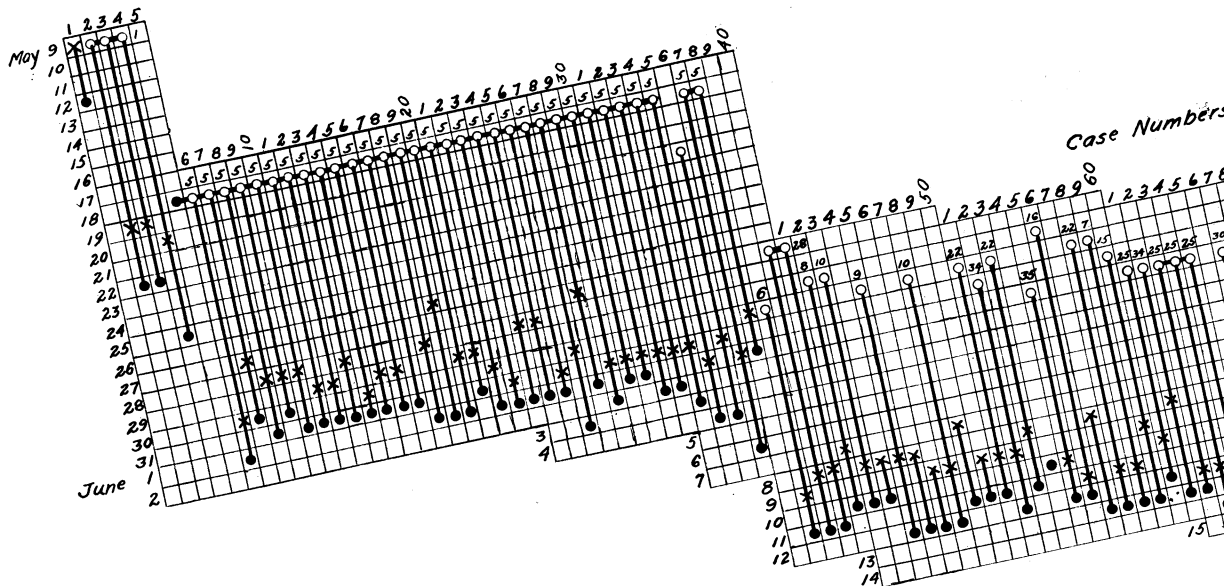
Measles had been absent from Palo Alto from June, 1913, to May, 1914; previously there had been only a few scattering cases for several years. As a result there was a comparatively large number of non-immune children, presenting a fertile soil for the development of the disease.

On May 12, 1914, a case of measles was reported in the person of C. M. G., a boy 10 years old. He had been in San Francisco sixteen days previously, but gave no history of contact with any case of measles, except that at the circus he had sat immediately in front of a girl who had a bad cold and inflamed eyes. On May 9 he felt ill; did not attend school (Saturday). On Sunday he went to Sunday school, but sat next to a boy who had previously had measles; not feeling well he did not mingle with the other children, but went directly home after the class was dismissed. He stayed home on Monday; on Tuesday he developed the typical rash. The disease was contracted by his mother and two sisters, but did not spread beyond the family.

On May 18, I. B., a boy aged 9 years, broke out with the rash of measles in one of the class-rooms in a primary school. He had apparently had a slight cold for several days, but his condition had not seemed to warrant medical attention, and his real condition had not been recognized. He had not come into contact in any way with the previous case, C. M. G., but had been to San Francisco on Sunday, May 3, fifteen days before, and as there were no other cases with which it was possible to connect him, and as it later developed that there had been many cases of measles in San Francisco at that time, it was assumed that he had obtained his infection there. The boy was at once sent home and isolated, but the entire class had been well exposed.

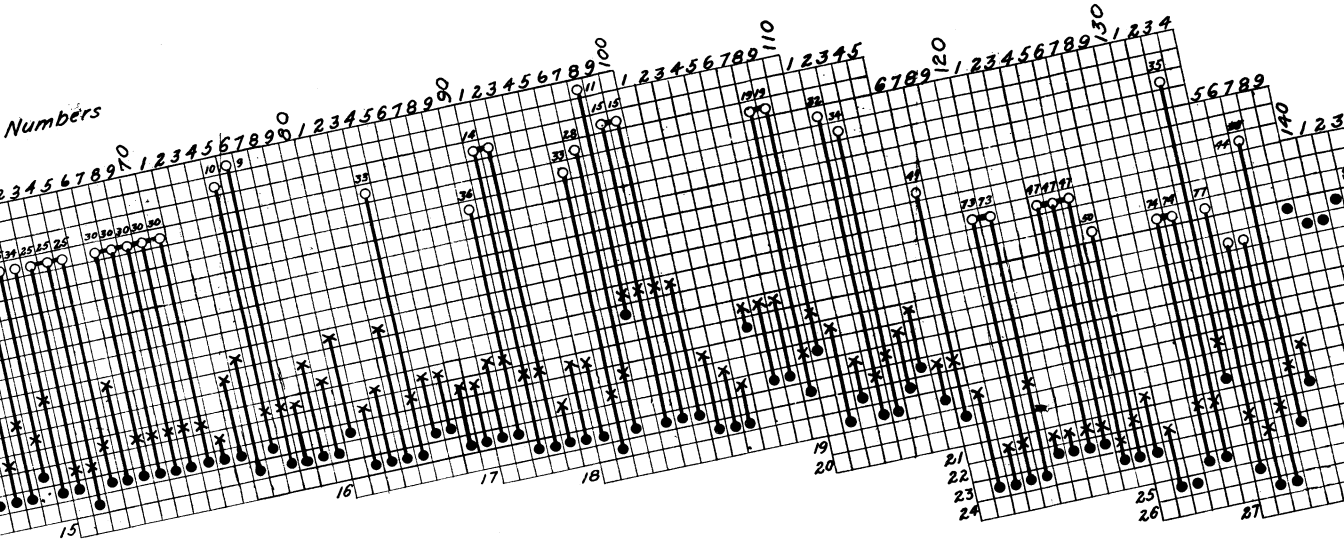
It was considered inadvisable to close the class-room for only one case of measles, and it was further considered advisable to keep the children in school, where they could be properly observed and sent home to be isolated on the appearance of the first suspicious symptoms. The children were examined before they entered school in the morning. The usual period of incubation being considered to be about 10 days from exposure to first symptoms, it was expected that the contacts would begin to show symptoms on Thursday, May 28, since the boy had probably not been infective on Friday, May 15, and there had been no school on the Saturday and Sunday following.

I asked Dr. H. W. Chappel to examine the children exposed to the case I. B. on the morning of the 28th, and to exclude those who were suspicious. He found 1 child with suspicious symptoms, and 2 absent. On Friday morning, May 29, I arrived at the school about 10:30 a. m. to find it practically closed, and the children I wished to examine scattered at various places in the city, practicing for the exercises to be given the following day, Decoration Day. An endeavor was made to find these children to examine them, but this was possible for only about one-half of the class, some of whom were suspicious and were ordered to be isolated. The remainder attended the Decoration Day exercises the following day, several of them, as it afterwards developed, having a coryza in the acutely infectious stage. Here they exposed



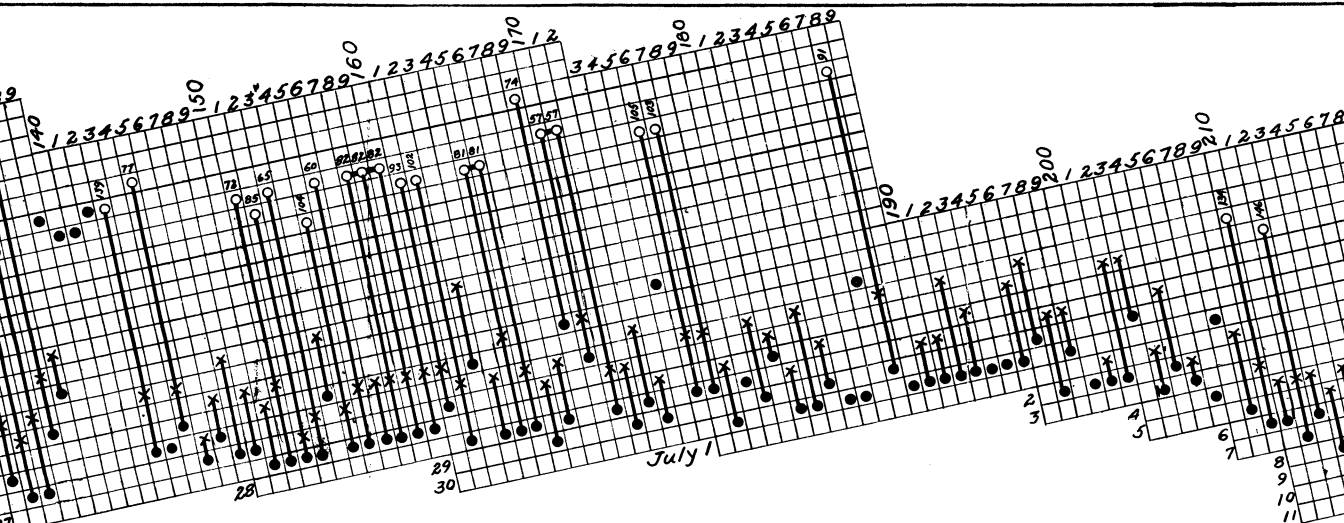
Legend

Exposure
First Symptoms
Exanthem
Case to which exposed



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 39
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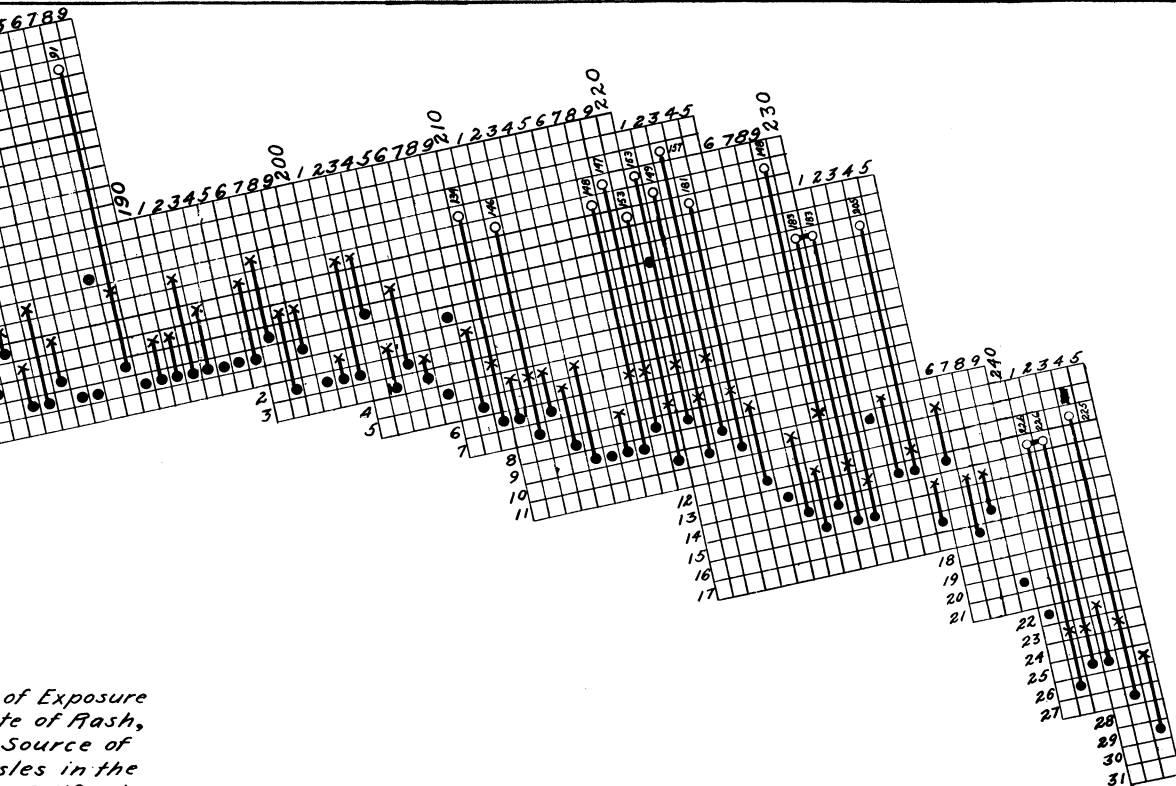
posed



DIAGRAM

*Showing Distribution, Date of Exposure
Date of First Symptoms, Date of Rash,
Period of Incubation, and Source of
Infection in Cases of Measles in the
1914 Epidemic in Palo Alto, California.*

*Harold F. Gray,
Health Officer.
March 31, 1915.*



of Exposure
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F. Gray,
 Health Officer.
 March 31, 1915.

not only the children in their own school, but also in the three other city schools. Through a combination of circumstances the effort to confine the disease to one class-room had completely failed. The following Sunday, May 31, 9 definite cases were reported and a number of suspicious cases developed. Fifteen cases in all were reported in May.

Since practically all the school children in the city had been exposed, it was beyond the power of the department to handle the situation by morning inspection of all the children, and no funds were available to augment the department temporarily by appointing a number of physicians as medical inspectors. It was therefore decided to call the attention of the parents to the situation by closing the schools on Monday, Tuesday, and Wednesday, June 8, 9, and 10, which would be 9 to 11 days after the exposure, and sending each child home previous to the closure with a printed notice calling the attention of the parents to the situation, advising them to keep their children home during those days, watching them for suspicious symptoms, and keeping them home on Thursday also if in any way suspicious or not in normal health.

Instead of doing any good, this closure of the schools served in turn to spread the disease, as the parents in most cases let the children run wild, mingling even more than if school had been in session. The children at once started to attend the motion-picture houses, which were then immediately closed to them. If any good could have come from closing the schools, it perhaps would have resulted if the schools had been kept closed for the entire week, for the next batch of cases was reported on Saturday, June 13, and Sunday, June 14. But the conditions mentioned make it doubtful whether the closing of the schools had any beneficial effect. It probably did more harm than good.

The cases then occurred in somewhat cyclical order, with peaks about two weeks apart, comparatively few cases being reported in the intervening time. There were reported 177 cases within the city limits in June, 50 cases in July, and 1 in August, when the outbreak ceased.

At the beginning of the epidemic the department rule in regard to exclusion from school and isolation was enforced. This called for placarding, isolation, and exclusion from school of all members of the family for a period of 3 weeks from the date of appearance of the rash. The experimental work on the transmission of measles in monkeys by Anderson and Goldberger, Nicolle and Conseil, and Lucas and Prizer, showed that measles probably is not infective after convalescence is well established, and that the desquamation scales are not infective. This would indicate that a 3 weeks' isolation period is excessive, and that 2 weeks would be ample and probably 1 week sufficient. It was also believed on general principles that measles was rarely, if ever, transmitted by third persons or fomites, and that there was therefore no need to exclude from school the other children in the family during the earlier part of the incubation period. Therefore I reduced the period of isolation and exclusion from school to 10 days, and permitted contacts to attend school for

a period of 7 days after the date of probable first exposure to the infective stage of a case, which was assumed to be 4 days before the appearance of the rash. It was also decided to omit terminal disinfection as useless and a waste of funds. With a few minor variations these regulations were carried out for the greater part of the duration of the epidemic.

It should be noted in connection with the Palo Alto outbreak that the entire bay counties section was visited by an epidemic of measles during the same period, and that when all conditions are taken into consideration Palo Alto suffered relatively less in proportion to susceptible population than the other communities.

Only about one-half of the cases were seen by physicians and by them reported to the department, the remainder being diagnosed at school by the writer, or diagnosed by him at the patients' homes on report of the parents to the department. According to the best available estimate not more than 10 cases within the city limits were unreported, an estimate which would indicate a percentage of cases of measles reported exceeding 95%.

CASE RECORDS

The record of each case of measles was kept on a separate card form, and filed in a card index in the same manner as other case reports are filed. The essential information on these forms was as follows: name and age of patient, residence, school or occupation, physician, date reported, character and date of first symptoms, date of exanthem, source and date of infection, and the names, ages, and residences of persons exposed to the case; also the date when quarantined, isolated, or placarded, and the date released.

Only the cases occurring within the incorporated limits of the city were reported by the city health office to the state board of health; those within the school district, but outside the incorporated limits of the city, were reported to the county health officer, and were kept under supervision. Cases outside the city limits were recorded on the same forms as for other cases, but were kept in a separate file, and were identified by serial letters, the city cases being identified by serial numbers. In compiling the records of this epidemic for the present paper, all the cases were taken and arranged in the order in which they were reported, regardless of the date of the exanthem.

In every case the record was made from information obtained by inquiry of the parent or other person in charge of the case, and was as full as possible. Only such data were included as seemed to be reasonably exact and certain. In a few cases but little could be defi-

nitely ascertained except the date of rash; in a number of cases the data were fairly complete except for the source and date of infection, which might have been one of several cases on one or more days, in which event the source and date of infection were recorded as uncertain.

TABULATIONS BASED ON THE CASE RECORDS

In order to simplify the presentation of case records, and to exhibit the most important points graphically, I append two diagrams, the first showing 245 cases with their data on the date of exposure, the case to which exposed, the period from exposure to first symptoms, the date of the first symptoms, the period from first symptoms

TABLE 1
STATISTICS OF AN INVESTIGATION OF THE OUTBREAK OF AN EPIDEMIC OF MEASLES

From Exposure to First Symptoms		From First Symptoms to Exanthem		From Exposure to Exanthem	
Days	Number of Cases	Days	Number of Cases	Days	Number of Cases
7	1	1	21	11	4
8	4	2	62	12	25
9	15	3	73	13	34
10	37	4	40	14	34
11	24	5	17	15	16
12	25	6	3	16	9
13	15	7	4	17	3
14	4	18	1
				19	1
Average 10.87	Total 125	Average 2.98	Total 220	Average 13.66	Total 127

to exanthem, the date of exanthem, and the total period from exposure to rash; the second showing the number of cases occurring on each day of the epidemic, taken from the first diagram, and showing also the average total incubation period of the disease. These two diagrams are based on 245 of the 254 cases occurring during the same period, the remaining 9 being excluded from the table on account of incomplete data.

I next present the following tables. Table 1 shows, for 125 cases, the period from exposure to first symptoms, and gives the average period in days; for 220 cases, the period from first symptoms to exanthem, and the average period in days; and for 127 cases, the period from exposure to exanthem, and the average period in days.

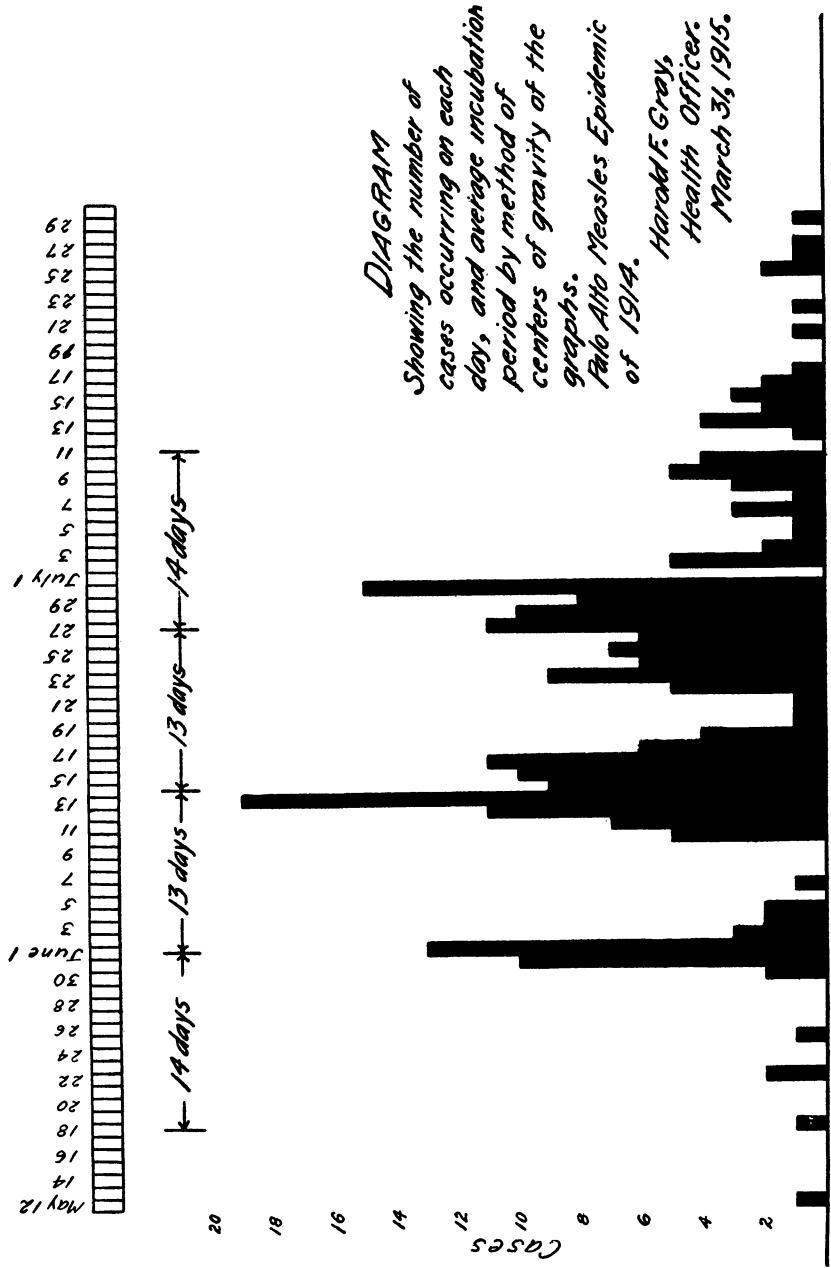


Table 2 shows, for 254 cases, the age distribution of the cases for males and females, and the totals for both sexes; also the average ages of males and females, and the average age of all patients of both sexes.

ANALYSIS OF TABULATIONS

Table 1 shows that for 125 cases for which such data were available with a reasonable degree of accuracy the minimal period in days from exposure to the appearance of the first symptoms of measles

TABLE 2
AGE AND SEX OF CASES

Age	Males	Females	Total
Under 1.....	1	...	1
1.....	6	4	10
2.....	8	3	11
3.....	6	8	14
4.....	8	7	15
5.....	8	6	14
6.....	19	8	27
7.....	15	14	29
8.....	13	23	36
9.....	13	19	32
10.....	12	3	15
11.....	6	6	12
12.....	2	2	4
13.....	4	3	7
14.....	4	5	9
15.....	1	3	4
16.....	1	1	2
18.....	2	...	2
24.....	...	1	1
28.....	...	1	1
30.....	...	2	2
31.....	1	...	1
32.....	...	1	1
33.....	...	1	1
35.....	...	1	1
40.....	...	1	1
45.....	...	1	1
Totals.....	130	124	254
Average age of males..... 7.6 years			
Average age of females..... 9.5 years			
Average age, all cases..... 8.5 years			

was 7 days, observed in one case; the maximal period was 14 days, observed in 4 cases; the average period was 10.87 days, or, for practical purposes, about 11 days.

For 220 cases for which data were available, the minimal period from the date of first symptoms to the date of exanthem was 1 day, observed in 21 cases; the maximal period was 7 days, observed in 4 cases; the average period was 2.98 days, or, for practical purposes, 3 days.

Table 1 also shows the total period of incubation in days from exposure to the exanthem, for 127 cases. The minimal period was 11 days, observed in 4 cases; the maximal period was 19 days, observed in one case; the average period was 13.66 days, or, for practical purposes, about 13.5 days. If now we turn to Chart 2, showing the number of cases reported each day during the outbreak, we find from this chart, by graphic methods, the average incubation period for the 245 cases to be 13.5 days. From the first case to the center of gravity about a vertical axis of the first group of cases we find that the incubation period was 14 days; from the center of gravity of the first group of cases to the center of gravity of the second group of cases the incubation period was 13 days; from the center of gravity of the second group of cases to the center of gravity of the third group of cases it was 13 days; and from the center of gravity of the third group of cases to the center of gravity of the fourth group of cases the incubation period was 14 days; the average of these periods was 13.5 days. This coincides very closely with the average by computation from selected cases.

Table 2 shows the distribution of 254 cases according to age and sex. Of these cases 130 were males and 124 were females—a slightly greater proportion of males, especially in view of the fact that there are slightly more females than males in the population. The average age of the females was 9.5 years, and of the males 7.6 years. The higher average age of the females was caused by two factors, one the greater number of females of mature years affected—a result largely of coming into closer contact with patients in nursing them—and also of the fact that the greatest rate of incidence among the females was at the age of 8 years, as against 6 years among the males.

The data on multiple attacks are too meager and uncertain to be of value. The data on complications and sequelae are of but little value, as a careful record was not kept of minor sequelae. The majority of cases were mild, only one serious case being reported. The only important sequelae noted were 3 pneumonias. There were no deaths.

THE STAGE OF THE DISEASE AT WHICH MEASLES IS CONTAGIOUS

During the epidemic very careful inquiry was made to determine as closely as possible the stage of the disease at which the patient infected a subsequent case. In 123 cases it was possible to trace, with comparative certainty, not only the case to which the patient had

been exposed, but the date and time of exposure. In 116 cases it was demonstrated that the patient had been in contact with one or more cases of measles, in each instance before the exanthem appeared. In a number of instances the patient had been in contact with the previous case both after and before the appearance of the exanthem; but if we assume an average incubation period of from 13 to 14 days, the time of infection must have been usually before the appearance of the rash. In 6 cases it was not possible to trace the infection at all. In no instance, however, was it possible to trace the infection to a previous case after the patient in the previous case had been released from isolation, even tho the period of isolation had been as short as 7 days from the appearance of the exanthem, and the patient released while the desquamation was still proceeding.

All the data obtained in this epidemic show very strongly that measles is contagious from the appearance of the first symptoms of the disease, but not before, and is not contagious after 7 days from the appearance of the exanthem, possibly even a less time. The height of the contagious period is probably on the day of the appearance of the rash, 73 of the 123 cases which were traced with a reasonable degree of certainty being infected at that time. In one case it seemed most probable that the infection had occurred on the second day after the appearance of the rash in the previous case. This was the only case in which the infection could have occurred after the appearance of the rash in the previous case.

In work on monkeys, Anderson and Goldberger have shown that the virus is contained in the blood and in the buccal and nasal secretions, and that 36 hours after the appearance of the exanthem the blood largely loses its infectivity. They also indicated strongly that the buccal and nasal secretions lose their infectivity with the beginning of convalescence. They completely failed to transmit the disease by means of the "scales." Nicolle and Conseil infected the bonnet monkey with blood drawn from a case of measles 24 hours before the appearance of the exanthem. Further experimental proof, corroborating these experiments in whole or in part, have been reported by Hektoen and Eggers, and by Lucas and Prizer.

This experimental evidence, taken with the epidemiologic evidence presented in the cases studied in this epidemic, seems to warrant the following conclusions:

1. A case of measles may be in the infective stage as early as 5 days before the appearance of the exanthem, but not before the appearance of prodromal symptoms.

2. The height of the infectivity occurs with the appearance of the exanthem.

3. The infectivity of the disease does not extend beyond 7 days after the appearance of the exanthem, and probably does not extend beyond the establishment of convalescence in normal cases.

PAST REGULATIONS FOR THE CONTROL OF MEASLES

Whenever there has been a lack of precise knowledge of the causative organism of a communicable disease, or of the period of infectivity and method of transmission of that disease, it has been the general principle of health authorities to make regulations which are doubtless in excess of the actual requirements. We do not know the causative organism of measles at the present time, and it is only recently that we have had any definite information as to the manner of its spread. Therefore, the restrictions placed about cases of measles have in the past been justly made in excess of the probable requirements, and even very recent regulations have been made which are excessive.

Bulletin 62 of the United States Public Health and Marine Hospital Service gives the following data on isolation periods for measles in different states:

(a) Twenty-seven days in North Carolina (may be reduced by local health authorities). Exposed persons 14 days from date of exposure.

(b) Twenty-one days in Missouri, Pennsylvania (or until physician certifies in writing that the patient is well and that nasal irritation and ear discharges have ceased), and Vermont (or until all complications are over).

(c) Fourteen days at least, or until desquamation has ceased, in Indiana, New Hampshire, North Dakota, Oregon, Utah.

(d) Fourteen days from disappearance of rash in Maryland.

(e) Ten days after appearance of last case in the house in Florida and Minnesota.

(f) Ten days in Ohio.

(g) Until recovery in Tennessee, and District of Columbia.

(h) Until desquamation is complete in Montana.

(i) Until skin and mucous surfaces are clear in New York (usually 21 days).

(j) Ten days after desquamation is complete in Idaho.

(k) Until catarrhal symptoms have disappeared in Arkansas.

Measles is required to be placed under absolute quarantine (all members of the family restricted) in Oklahoma and Montana (except breadwinners under certain precautions). The patient and exposed persons are required to be isolated in Arkansas, Kentucky, Arizona (except breadwinners), and Florida (except breadwinners). Patients and susceptible children are required to be isolated in Minnesota. The patient only is required to be isolated in the District of Columbia, Indiana, Michigan, North Carolina, North Dakota, Oregon, Utah, Vermont, and Washington. Placarding and reporting only is required in Kansas, Nebraska, South Dakota, Virginia, and Wisconsin. Measles is required by law to be reported in the District of Columbia, Alaska, Hawaii, Arizona, California, Idaho, Indiana, Maine, Maryland, Massachusetts, Montana,

New Hampshire, North Carolina, Pennsylvania, Texas, Utah, Wisconsin, and by regulation of the State Board of Health in Arkansas, Connecticut, Florida, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New York, North Dakota, Ohio, Oklahoma, Oregon, South Carolina, South Dakota, Tennessee, Vermont, Virginia, Washington, and Wyoming. No data are readily available as to the requirements in terminal disinfection in measles, but it has been rather generally practiced in the past.

The period of exclusion from school is generally the same as the period of quarantine or isolation in most states, with the following specific regulations:

- (a) Five days after release from quarantine in Indiana, Oregon, and Utah.
- (b) Fourteen days from disinfection of premises in the District of Columbia.
- (c) Fourteen days from beginning of last case in Maryland.
- (d) Twenty-one days from onset of the disease in Idaho, Montana, and Utah.

Readmission to school is usually granted only upon presentation of a permit from the local health authority, but in 8 states may be granted upon presentation of a certificate from either the local health authority or the attending physician, or from the attending physician alone in 7 states.

No attempt has been made to digest the requirements of the different cities or other sanitary units, as the state requirements show approximately as wide a variation as the municipal requirements would show. The only municipal regulations which will be here presented are those of New York City, for the reason that they mark the most radical step yet taken in reducing the period of isolation of cases of measles. The following is quoted from the New York City Hand Book of the Bureau of Infectious Diseases for 1914, Sec. 80:

Incubation period 12-14 days. Quarantine period five days after the appearance of eruption if no catarrhal discharges are present, cough has stopped, and patient is otherwise well. On August 15, 1913, the quarantine period for measles was reduced to five days after the appearance of the eruption. That this procedure was justified is evidenced by the fact that there has been no increase in the occurrence of secondary cases.

In Sec. 53 instructions are given regarding placarding and exclusion of all children in family from school. In Sec. 55 instructions are given regarding cleansing and airing of the sick-room on termination of quarantine. On termination of quarantine school certificates are issued to the patient and to other children who have had measles; otherwise, the children are excluded for 14 days.

PALO ALTO REGULATIONS FOR THE CONTROL OF MEASLES

Previous to the epidemic the local regulations regarding measles had been as follows: The patients and all children and members of the family were excluded from school, and the premises placarded

and quarantined (modified quarantine, the breadwinner not being restricted) for a period of 3 weeks from the appearance of the rash in the last case.

The present regulations for the control of measles (adopted as regulations of the Board of Public Safety) are as follows:

General Regulations.—"Patients shall be isolated upon the premises for a minimum period of seven (7) days from the appearance of the rash, except that in cases where there are children in the same family or building who have not previously had the disease, the minimum isolation period shall be ten (10) days, or longer if necessary in the judgment of the health officer. Adults, and children who have previously had the disease, and who are not in contact with the patient, shall not be restricted. Children in the same family with a case of measles, who have not previously had the disease, and other susceptible children who have been in immediate contact with the patient, need not be isolated for a period of eight days from the time of exposure, provided they are isolated from the patient, but shall thereafter be isolated for a minimum period of ten (10) days, or until all possibility of contracting measles has passed. A warning placard, containing the word "MEASLES" in plain and conspicuous letters, shall be conspicuously affixed to the premises upon which the patient is isolated, and shall not be removed until isolation is terminated."

School Regulations.—"No child or teacher who has been excluded from school on account of a communicable disease shall be readmitted to school until he or she has been examined by the health officer or a physician appointed by the health officer for such examination, and has obtained a written permit from the health officer to return to school. Teachers shall exercise due diligence in observing children for the early signs of communicable diseases, and shall send from school any children exhibiting suspicious symptoms or abnormal conditions, and shall promptly report the fact of such exclusion to the health officer. In an epidemic of measles all children having coryza or inflamed eyes shall be excluded until all possibility of measles has passed. Children in the same family with a case of measles and who have not previously had measles, if the patient is isolated may be permitted to attend school for seven days from the first contact with the case, and shall thereafter be excluded for ten days. Children

who have previously had measles, if the patient is isolated, may be permitted to attend school at the discretion of the Health Officer."

It should be noted that in case there are other susceptible children in the family, the period of isolation is increased from 7 to 10 days. This is done for reasons of convenience and efficiency, for if the case were released at the end of 7 days it would be necessary to return at the end of about 10 days from the exposure to determine whether the other susceptible children were coming down with the disease. By lengthening the period to 10 days where there are susceptible contacts in the same family or on the same premises, one trip is eliminated.

THE MANAGEMENT OF MEASLES EPIDEMICS

One of the first difficulties which the administrative officer finds in the control of measles is the fact that, being highly contagious prior to the appearance of the rash, and but little if at all contagious after, it is seldom possible to get cases isolated until they have had considerable opportunity to spread the disease. The difficulty is still further increased by two common conditions: first, the parents of the patient usually think that the child has merely a bad cold, and do not isolate the child at once; second, in many cases no physician is called in, and the case may not be reported to the health department. Under average conditions probably not one-half of the cases of measles are reported; these act as foci for additional cases. Ambulant cases in the eruptive stage, and carriers, are rare, so that it is doubtful whether they play any significant part in the spread of the disease. The problem of control becomes, therefore, the problem of the early recognition and reporting of cases, and prompt isolation several days before the eruption appears.

It is impossible, even with the most highly organized system of medical inspection, to examine every school child every day of the school year before the child enters the schoolroom. It is possible, however, to train the teachers, who observe each child every day, to recognize the slightest departure from the normal. Every child departing from the normal can be at once sent to the school office, and there examined by the health officer, or a medical inspector, or school nurse, and excluded from school if any suspicious symptoms are present. This procedure can be worked out in any community having an organized health department, and will do much to limit the spread of other communicable diseases as well as measles. In

measles the general prodromal symptoms are coryza, inflamed eyes, fever, cough, and Koplik spots, tho aside from the increase in temperature these symptoms are not constant, some cases exhibiting one combination of symptoms, other cases another combination. Cotter¹ and Lorand,² among others, have reported cases in which Koplik spots were not observed prior to the appearance of the exanthem; but in every case observed by the writer or the local physicians before the appearance of the exanthem, Koplik spots were observed. The period before the appearance of the rash when Koplik spots were observed varied from as short as 1 day to as long as 7 days. Observations with a clinical thermometer were carried out only in the cases of certain high school students near the end of the epidemic (on account of final school examinations, these students, who would otherwise have been excluded, were permitted to attend school after observation each morning); of some 15 students so examined, 2 showed a slight rise in temperature simultaneously with the appearance of Koplik spots, and were excluded, later developing typical cases.

I am of the opinion that in each school the teachers, if no school nurse or medical inspector is available, can be taught to use the clinical thermometer, and to observe the palate and buccal membranes for Koplik spots. Then, in case the health officer cannot be at the school within a reasonable time (during which the suspected children should be kept by themselves away from the other children in school), the teachers can take the temperatures and examine the throats, and send home, with printed instructions to isolate, any children showing a temperature above normal, or Koplik spots. These children should be reported to the health officer, and investigated by him as soon as possible. In this way, even without organized school medical inspection, it will be possible to exclude from school at an early stage of the disease, and isolate, such children as are about to develop measles. Possibly under such a system a number of children will be sent home who are not about to develop measles, but as this is an error on the side of safety, and as such children can be returned to school if after subsequent examination they prove to be normal, the advantages of this method outweigh the disadvantages. A few cases might be missed by such unskilled examination, but the general gain would be considerable.

1. Arch. Pediat., 1900, 17, p. 918.

2. Jahrb. f. Kinderh., 1901, 3, 658.

At the present time the Palo Alto health department maintains in each local school an equipment to facilitate such examinations, which consists of two clinical thermometers, sterile wood tongue-depressors, 70% alcohol for disinfecting thermometers (bichlorid is objected to for use in schools on account of its highly poisonous properties), sterile cotton, record blanks, serum tubes and swabs for diphtheria, etc. The department is instructing the teachers, by means of lectures and demonstrations in the use of such equipment, in the recognition of the prodromal symptoms of the common communicable diseases, and informing them as to the rules and regulations of the department concerning communicable diseases and exclusion from school.

While these measures work out very well in practice in Palo Alto, and should work equally well in any small city with an organized health department, we have not lost sight of the fact that in order to attain any marked measure of success it is necessary to have the understanding and co-operation of the parents of school children, and to obtain the reporting of cases not in school. To attain the first object I have always, upon placarding or releasing cases, explained to the parents of patients just what the rules and regulations were, and the reason for them. Occasional use of the local newspaper for publicity concerning the necessity of reporting cases is advisable and helps greatly. In the case of children excluded from school on account of suspicious symptoms, a notice is sent with the child to the parents, setting forth the early symptoms of the suspected disease (or the disease to which the child has been exposed), advising the parents to observe the child closely for such symptoms, and notifying them that the disease must be reported to the health officer. If a new case of disease should appear among the children in school, this notice is sent home to the parents of all the exposed children. To reach those persons who do not have children in school, an advertisement is occasionally inserted in the local paper, notifying the people that cases of communicable disease must be reported, and stating what diseases are reportable; also stating that any person failing or refusing to report a case will be prosecuted. So far it has never been necessary to bring any case to trial, tho several warrants for arrest have been issued, and fines imposed. We endeavor to have people report cases as a civic duty, rather than hold the club of the law over their heads to compel them to report.

It is not necessary to accept measles as an inevitable disease of childhood, or to consider that it is impossible of control by proper measures and by the utilization of every available agency toward preventing its spread. If it had not been for an unusual and unfortunate combination of circumstances at the critical point, the epidemic which is reported in this paper would in all probability never have spread beyond the patients exposed to the original case I. B. It is entirely profitless and aside from the question to argue that children will have measles anyway, and that it is better for them to have it early in life and get it over with. This is a most pernicious doctrine, which could have been applied with equal force to any of the more serious contagious diseases, such as diphtheria or smallpox or typhoid, before we learned how to control them. Measles is at present a sufficiently important cause of death to warrant strenuous measures for its control.

CONCLUSIONS

From a study of an epidemic of 254 cases of measles when considered in connection with recent laboratory work on the disease, I believe that the following conclusions are justified:

The minimal period from exposure to first symptoms was 7 days; the maximal, 14 days; the average 11 days.

The minimal period from the appearance of the first symptoms to the appearance of the exanthem was one day; the maximal, 7 days; the average 3 days.

The minimal period from exposure to the appearance of the exanthem was 11 days; the maximal, 19 days; the average 13.5 days.

The distribution between the sexes was very nearly equal, with a slightly greater number of males than females.

The average age of cases was, in males, 7.6 years; in females, 9.5 years. The incidence was greatest in males at 6 years of age, in females at 8 years.

The cases in this epidemic were generally mild in character, only one severe case being reported. There were no deaths. The rate of attack per 10,000 of population was 487 (258 cases within the city limits in 1914 for a population of 5,300). Estimating an average case fatality of 4%, we might have expected about 10 deaths. That they did not occur may be attributed to the mild character of the outbreak, to a very general intelligent care of the cases, and to the excellent sanitary condition of the city.

Measles may be infective as early as 5 days prior to the appearance of the exanthem; the appearance of the rash marks probably the height of the infectiousness of the disease; the infectivity does not extend beyond 7 days after the appearance of the rash, and is probably shorter. The experience of the New York City department of health is that the disease is probably not infective 5 days after the appearance of the rash, and the experiments on monkeys would indicate that the infectiousness ceases with the approach of convalescence.

In view of the conclusions set forth in the previous paragraph, it is apparent that the usual regulations in force for the control of measles are excessive on the one hand and inadequate on the other.

For the control of measles it is essential that, in addition to a full and complete reporting and isolation of all cases, we take steps to make possible the early recognition of cases.

To make the early recognition of cases of measles possible, it is necessary that we educate parents as to the importance of the disease and its danger, and to train teachers to recognize the prodromal symptoms, or at least to recognize the slightest departure from the normal in any school child. Teachers can be instructed how to use a clinical thermometer, and to observe the throat for Koplik spots. Since small cities and towns, and rural districts, do not have available funds for the maintenance of adequate medical inspection, the co-operation of parents and teachers is especially important in such communities.

The essential points in regulations for the control of measles are: The case shall be recognized and isolated at the earliest possible moment; the premises upon which the case is isolated shall be placarded; the patient shall be isolated for at least 5 days after the appearance of the exanthem; adults and children who have previously had the disease need not be restricted, but it is advisable to warn them as to the slight possibility of second attacks, and keep them under observation; children who have not previously had measles and who are in contact with cases, need not be restricted for 7 days after contact, but should thereafter be isolated for at least 10 days and carefully observed. Disinfection after measles is useless and unnecessary.

Transmission of measles by third persons or fomites must be exceedingly rare, if it occurs at all.